Introduction

Human activities have numerous and complex effects on the natural environment. Some of these effects are immediate and direct (such as impacts from construction activities), while others take time to unfold or are geographically removed (such as a change in program policy). Although single large projects and activities often have very severe impacts on the environment, a large number of small activities over time may have an even more serious impact. Cumulative effects on the human environment are defined by the Council on Environmental Quality (CEQ) regulations as:

> *The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such other actions*
> *-Title 40 CFR §1508.7*

CEQ regulations implementing the National Environmental Policy Act (NEPA) require Federal agencies analyze the cumulative effects of their actions on the environment. This means that cumulative effects must be addressed in an Environmental Impact Statement (EIS) or Environmental Assessment (EA), and in screening projects that are normally categorically excluded from NEPA analysis (CATEX actions). In January 1997, CEQ published the guidance document, "Considering Cumulative Impacts under NEPA." This fact sheet is based on the CEQ guidance and discusses cumulative effects analysis in a GSA context. However, the CEQ guidance provides far more detailed direction and specific analytic methods, and should be reviewed before analyzing the cumulative effects of a proposed action.

What Are Cumulative Effects?

It may be easiest to understand what cumulative effects are by considering the following two examples.

- Imagine that GSA is considering ways to provide Federal office space in a city. One alternative is to build a new office building close to several local government office buildings that have been constructed in the last ten years. Suppose that the existing buildings and GSA proposed building site are adjacent to a residential neighborhood. It is very likely that the construction of the office buildings over the last ten years has impacted the neighborhood and driven property values up or down. The office workers may have created markets for goods and services that did not exist before, causing changes in the local retail economy. Road, utilities and other infrastructure was upgraded, and traffic increased. These are all effects (negative or beneficial) on the human environment, but since they were not the result of Federal action, they have probably not been subjected to NEPA analysis. If constructed, the GSA building may contribute to the effects that are accumulating because of multiple individual office building construction projects. These are cumulative effects.

  Moreover, construction of the GSA building may encourage further office building development in the area, incrementally transforming the character of the neighborhood. These potential effects are also cumulative; they are not the effects of the GSA building all by itself, but the effects of the GSA building as part of an overall trend or pattern of development. The effects accumulate as more and more office buildings are built, perhaps eventually resulting in the

complete transformation of the neighborhood. NEPA analysis must address the impacts of the GSA building in the context of this overall pattern of development and environmental change.

- As another example, imagine that GSA is responsible for disposing of an excess Air Force base. One possible development scenario for the base is its acquisition and operation by a consortium of airfreight companies; another possibility is its use as a light industrial complex with no air operations.

  Adjacent to the base is habitat for the "speckled sparrow," a threatened species. The Air Force base, which was constructed long before enactment of NEPA and the Endangered Species Act, has probably affected the sparrow's behavior; air operations have startled nesting birds and caused them to relocate their nest sites. Meanwhile, the habitat within which the bird can nest has shrunk over the years, as the result of industrial and residential development along the river. The Fish and Wildlife Service is now working with local governments on a program of habitat protection and restoration.

In simplest terms, analyzing cumulative effects means considering the impacts of a proposed action in the context of everything else that is going on, has gone on, or probably will go on in the vicinity.

Principles of Cumulative Effects Analysis

Figure 1 presents some basic principles that the CEQ guidance says must be understood when undertaking cumulative effects analysis. Like other kinds of environmental impact assessments, cumulative effects analysis has three main components: scoping, description of the affected environment, and determining the environmental consequences of the proposed action. The CEQ guidance outlines eleven "steps" that make up these three components, which are described in greater detail in the sections below.

Scoping for Cumulative Effects

Proper scoping is critical if potential cumulative effects are to be identified and analyzed in an EA or EIS. Scoping should include considering what is currently going on in the area or areas where the action and alternatives would occur, and what is likely to go on there in the foreseeable future. Is the area undergoing development? Are aspects of the environment being degraded or enhanced by human or natural forces? Evidence of such changes should be sought in pertinent studies and other literature, through first-hand observation, and importantly through consultation with relevant agencies, experts, and stakeholders. Taking such perceived changes into account, scoping should establish the time frame of the NEPA analysis, its geographic scope, and the kinds of analysis that will have to be performed. The CEQ identifies four steps in the scoping process:

Step 1: Identify the significant cumulative effects issues associated with the proposed action, and define the assessment goals.

The first stage of the scoping process is to distinguish between cumulative effects that may be significant from those that will probably not be significant. Several tests can be abstracted from the CEQ guidance which, when applied to potential cumulative effects issues, can help determine if each should be included in the scope of the assessment. One set of tests deals with potential effects that

have been analyzed in the past:

What cumulative effects have been previously identified in the area? Reviewing previous studies is a basic part of any scoping effort. Look at prior environmental analyses, academic studies, government studies, and media reports.

Have past impacts been historically significant? It may or may not be possible to answer this question during scoping, but asking it will help to focus attention on significant potential impacts. Obviously if prior studies have shown that a theoretically possible cumulative effect is not significant, then (assuming the prior studies are reliable) it should not be necessary to analyze this effect with respect to the action now under review.

Does the proposed action entail any known cumulative effects that have been previously determined to be significant on a local scale (e.g., effects on low-income or minority communities), regional scale (e.g., long range transport of air pollutants), or global scale (e.g., global warming through greenhouse gases)? Based on past studies, are there any obvious "red flags"-any ongoing or developing environmental problems (or opportunities) that need to be given special attention in the current analysis? Another set of tests relates to possible cumulative effects that have not yet been formally identified. The scoping analyst should look at the various attributes of the environment that might be affected by the action and ask:

What is the value of the environmental attribute (e.g., the resource, community, or ecosystem)? Value, of course, is largely subjective. It may be useful to consider value with respect to context as discussed in the CEQ regulations (40 CFR 1508.27): How valuable is the environmental element to the nation or region? To particular affected interests? In cumulative effects analysis as in all other NEPA studies, these contexts are not hierarchical-impacts on the nation are not necessarily "worse" than impacts on a region or an affected group, and the fact that the former may be positive should not be an excuse from considering the latter. Consider factors like whether the environmental element is the subject of its own laws or regulations, whether it may be important to maintaining a quality regional or local environment, and whether it is perceived to be important by a local group.

Figure 1 **Principles of Cumulative Effects Analysis***
1. Cumulative effects are caused by the aggregate of past, present, and reasonably foreseeable future actions. The effects of a proposed action on a given resource, ecosystem, and human community include the present and future effects added to the effects that have taken place in the past. Such cumulative effects must also be added to effects (past, present, and future) caused by all other actions that affect the same resource
2. Cumulative effects are the total effect, including both direct and indirect effects, on a given resource, ecosystem, and human community of all actions taken, no matter who has taken the action. Individual effects from disparate activities may add up to or interact to cause additional effects not apparent when looking at the individual effects one at a time. The additional effects contributed by actions unrelated to the proposed action must be included in the analysis of cumulative effects.

3. Cumulative effects need to be analyzed in terms of the specific resource, ecosystem, and human community being affected.
Environmental effects are often evaluated from the perspective of the proposed action. Analyzing cumulative effects requires focusing on the resource, ecosystem, and human community that may be affected and developing as adequate understanding of how the resources are susceptible to effects.

4. It is not practical to analyze the cumulative effects of an action on the universe; the list of environmental effects must focus on those that are truly meaningful.
For cumulative effects analysis to help the decision maker and inform interested parties, it must be limited through scoping to effects that can be evaluated meaningfully. The boundaries for evaluating cumulative effects should be expanded to the point at which the resource is no longer affected significantly or the effects are no longer of interest to affected parties.

5. Cumulative effects on a given resource, ecosystem, and human community are rarely aligned with political or administrative boundaries.
Resources typically are demarcated according to agency responsibilities, county lines, grazing allotments, or other administrative boundaries. Because natural and sociocultural resources are not usually so aligned, each political entity actually manages only a piece of the affected resource or ecosystem. Cumulative effects analysis on natural systems must use natural ecological boundaries and analysis of human communities must use actual sociocultural boundaries to insure including all effects.

6. Cumulative effects may result from the accumulation of similar effects or the synergistic interaction of different effects.
Repeated actions may cause effects to build up through simple addition (more and more of the same type of effect), and the same or different actions may produce effects that interact to produce cumulative effects greater than the sum of the effects.

7. Cumulative effects may last for years beyond the life of the action that caused the effects.
Some actions cause damage lasting far longer than the life of the action itself (e.g., acid mine drainage, radioactive waste contamination, species extinctions). Cumulative effects analysis needs to apply the best science and forecasting techniques to assess potential catastrophic consequences in the future.

8. Each affect resource, ecosystem, and human community must be analyzed in terms of its capacity to accommodate additional effects, based on its own time and space parameters.
Analysts tend to think in terms of how the resource, ecosystem, and human community will be modified given the actions development needs. The most effective cumulative effects analysis focuses on what is needed to ensure long-term productivity or sustainability of the resource.

Adapted from Table 1-2 in CEQ publication: "Considering Cumulative Effects Under the National Environmental Policy Act"

How is the proposed action similar to others in the same area? For example, is the building being proposed like other buildings that have been constructed lately, or are being built, or are being planned, in the vicinity?

Do different kinds of action have the potential for similar environmental effects? Does the property transfer, construction of a new highway, and recreational hiking all contribute to shrinking the spotted sparrow's habitat?

Will the proposed action, in combination with other actions, affect resources that are of particular concern? This test brings together the results of answering the previous questions. Does it look like some aspect of the environment will be affected by actions that are similar to the one now being planned-either in type or in terms of effect-and does it look like the action now being planned will contribute to these effects?

Applying these tests during scoping involves not only making judgments based on professional assessment of available data, but also listening to the perceptions of stakeholders. Be alert to public comments like: "This project is just one more example of how this community is changing" or "This project could contribute to some very positive improvements that have been happening around here." Try to elicit from the concerned public just what it is about this project that they see as similar to others that are cumulatively affecting environmental values, and what those values are.

Step 2: Identify the geographic boundaries of the analysis.
The geographic scope of the cumulative effects analysis should at least match, and may often exceed, the project impact zone that is defined for direct and indirect project effects. Project impact zones are not political boundaries, but are the areas where environmental impacts are potentially significant. Project impact zones are likely to vary depending on the resource characteristics and environmental media. The analysis should be flexible enough to recognize and incorporate the differing scales of different types of effects. For example, the watershed is often the most appropriate unit for considering impacts to surface water, but effects on communities or air quality may have very different geographic scopes. For GSA projects in urban areas, the central business area, neighborhood, or entire city may be an appropriate impact zone, depending on the type of impact that is of concern. Once the project impact zones are identified, the institutional jurisdictions of the agencies involved with the proposed action or potentially affected resources, ecosystems, and human communities can be superimposed on them for purposes of analysis.

Studying cumulative effects may require looking at a broader geographic scope than is used for other effects. For example, the definable visual, auditory, and socioeconomic effects of the proposed new office building may be limited to a particular neighborhood, but the concern about the cumulative effects of development on the character of the community might extend to the entire city.

Step 3: Identify the time frame for the analysis.
The scoping analyst needs to decide how far into the past and future the analysis will look. In terms of past effects, there is usually some more or less clearly definable point in the history of the area at which, for example, development along the river or construction of office buildings in the neighborhood began. In terms of the future, the definition of cumulative effects requires that "reasonably foreseeable future actions" be considered. Is it reasonable to assume that current trends will continue, or are significant changes foreseeable? Will development along the river likely continue, or will it be slowed, halted, or reversed by efforts to protect the sparrow habitat? Are many more office buildings likely to be built, or is the community reaching a saturation point in terms of office space? In looking at the specific contribution to cumulative effects of the action being analyzed, at a minimum the analyst should consider the duration of significant direct and indirect impacts. In some cases a longer period of effects should be addressed. After a number of years the residual impact of a proposed action itself may no longer be significant, but may contribute to an overall significant impact

when considered together with the impact of a foreseeable future action. This possibility should be examined before limiting the time frame to the period of direct and indirect effect of the proposed action.

Step 4: Identify other actions that have contributed or may contribute to cumulative effects. This "step" essentially reiterates one of the tests to be applied during Step 1. It emphasizes the fact that the analysis of cumulative effects, by definition, must extend beyond the proposed action to past, present, and future actions that could magnify the impact of the proposed action. Extensive communication and coordination with other agencies and with knowledgeable local groups and authorities is critical to success in forecasting cumulative effects. The analyst may have only partial access to information on the past effects of actions on the environment. Some data may never have been collected, some may be available only for limited areas or time periods. As a result, qualitative analysis may be the best that can be achieved for past effects. Local historical libraries, universities and long-time residents may be the best sources of information for past disturbances and their effects. Data on present actions is more accessible, provided the analyst makes a thorough effort to determine the present activities of other agencies, local authorities, and private development projects. To begin the identification of future actions, the analyst must determine the plans of the proponent agency and other agencies in the area. A first step is to identify other Federal agencies' plans that are funded or are under NEPA analysis. Additional effort is needed to identify other plans in the early stages of formulation. This can only be achieved through close communication and cooperation with other agencies. But the process must not stop with other plans subject to the requirements of NEPA. The regulations require the inclusion of all reasonably foreseeable actions that could contribute to significant cumulative effects, regardless of the party responsible. The analyst should make inquiries of local planning agencies, zoning boards, water supply planners, economic development planners and permitting agencies to gather information on the types and extent of future projects and developments in the area of concern.

Since future actions are uncertain, assumptions must be made and explicitly stated in order to proceed with the analysis. In some cases, several alternative scenarios for projected future actions should be developed and explored, to capture a wide range of likely events. To prevent the analysis of all possible future actions from overwhelming the study, much of the data may need to be excluded. Future actions can be reasonably excluded from the analysis if:

- The potential for the future action is highly speculative;
- There is a strong likelihood that a project in the early planning stages will never be completed;
- The action is outside the legitimate geographic scope of the analysis;
- The action is planned for a future date beyond the reasonable time frame of the analysis;
- The future action will not affect the resources that are the subject of the cumulative effects analysis; or
- Inclusion of the action would be essentially arbitrary.

One important tool that should improve communication between agencies and enhance cumulative effects analysis is the Interagency Ecosystem Management Task Force (IEMTF), established in 1995. The IEMTF is a partnership among agencies that explicitly employs the ecosystem approach to identify, prevent, and mitigate cumulative effects from human disturbances. The IEMTF recommends that agencies develop regional ecosystem plans to coordinate review activities under NEPA.

Describing the Affected Environment

Describing the affected environment for purposes of cumulative effects analysis typically requires an expanded geographic and temporal scope compared to other kinds of effects, and more emphasis may be placed on potential system interactions. The CEQ identifies three steps in describing the environment: characterize the components and status of the environment, characterize the stresses affecting the environment, and define a baseline condition for the environment.

Step 5: Characterize the components and status of the environment
. In this step, the analyst begins with the information obtained in scoping, particularly the issues identified in Step 1. The list of identified issues is broken down into environmental components such as water and air resources; plants and wildlife, social and cultural resources, and socioeconomics. The status of the environment should be described in terms of how the key resources, ecosystems, and human communities have already been altered by human activity, and how they are being altered at the time of the analysis. Trends in conditions should be identified where possible. Careful attention should be given to system interactions that may not have been addressed during scoping. The existence of long-range or synergistic effects may expand the list of resources and processes that need to be considered.

There are many ways to evaluate the status and sensitivity of natural resources and ecosystems. Because biological communities integrate and respond to multiple stresses over time, the trained observer can evaluate the status of the community through the use of indicators. Indicators can be data such as soil pH, water clarity or organisms of varying sensitivity to stress whose presence or absence in the community reveal ecological health. The use of remote sensing and Geographic Information Systems (GIS) can provide a wealth of information on the status of resources. Some concrete indicators are also available for the status of human communities. These include economic statistics, information on the availability of social services, health statistics, and data on community ethnic, social, and cultural diversity, cultural resources, and other "quality of life" measures. Careful attention must be paid to defining the environmental elements important to or valued by low-income or minority populations (See Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" and the NEPA Call-In Fact Sheet: "Environmental Justice."

Step 6: Characterize the stresses on the environment. This step has two parts. The first is to describe how the resources, ecosystems and human communities are stressed under current and probable future conditions. The second is to consider how these stresses relate to the framework of regulations, plans, and other controls that structure human impacts on the environment.
The goal of characterizing stresses is to determine whether the resources, ecosystems, and human communities of concern are near or at a condition where additional stresses will have important cumulative effects. For example, a habitat may be eroded to the point where a population of an important organism can maintain itself only at a minimal density. If so, additional stresses introduced by the proposed action may bring the habitat below the point where the population can be sustained. This would be an important cumulative effect brought about by a small change in a highly stressed ecosystem. In an environmental justice context, a resource valued by a low-income or minority community for subsistence or cultural purposes (such as fish or medicinal plants) might be available only in such limited locations that making one or two more locations unavailable would effectively make it impossible for the community to continue its use of the resource.

When they exist, reliable prior studies may be useful in identifying and assessing environmental stresses. New research may be needed to accurately characterize stresses, or to augment existing studies. Study of the same environmental indicators used in characterizing the status of the environment under Step 5 may be useful in evaluating the kind and extent of stress on the environment. Analysis of historical aerial photographs can provide a wealth of data on certain kinds of stress trends, at low cost. The CEQ guidance lists information resources that may be available to the analyst (Figure 2)

Stress on the environment resulting from human activities is of course influenced by Federal, State, Regional, and local land use plans, regulations, and programs. The current and likely future impact of controls like zoning and ecosystem management planning should be considered in projecting future stresses and their effects. Stresses may be identified in such planning and regulatory documents, and provisions may be put forward for controlling them. On the other hand, planning, zoning, and development policies may themselves create or exacerbate stresses on the environment. Current and potential future stresses should be described and projected without reference to the action being analyzed, since the purpose of this phase of analysis is to define the conditions within which the action's impacts will occur if it is carried out.

Step 7: Define a baseline condition for the environment. The purpose of a defining a baseline condition for the resources, ecosystems, and human communities in the area of the proposed action is to establish a point of reference for evaluating the extent and significance of expected cumulative effects. To define a baseline, the analyst must use the data elements assembled under Steps 5 and 6. The baseline is in essence a summation and organization of the data collected and developed during the preceding steps of analysis. These data should be organized to produce a coherent picture of the current condition of the environment, and its likely future conditions without the action being analyzed.

For some kinds of environmental resources, the Environmental Monitoring and Assessment Program (EMAP) coordinated by the Environmental Protection Agency (EPA) may be of great help in establishing baseline conditions. See page 34 of the CEQ guidance for information on EMAP.

Determining the Environmental Consequences of the Proposed Action

In this stage of the process, the analyst uses information gathered in the previous steps to determine the significant cumulative effects associated with the proposed action. Considering cumulative effects is an iterative process and earlier steps may need to be revisited during this component of the process; the scope may need modification, or new cumulative effects may come to light. According to CEQ, this process involves four steps:

Step 8. Identify important cause-and-effect relationships. The environmental impacts of human activity are varied and often involve cascades of cause-and-effect relationships. Many of these relationships are not immediately apparent, but have been uncovered by research into the impacts of other actions in the past. The analyst must be familiar with the common chains of cause and effect associated with changes in the environment.

For example, what is it about industrial and residential development near the airbase that has restricted the sparrow habitat? Was it tree cutting, traffic noise, or human/sparrow interactions? Given these demonstrated relationships, what aspects of base reuse may exacerbate or relieve these impacts? What factors have caused neighborhood change in the vicinity of the office buildings? Was it an increase or decrease in property values, the introduction of new stores, or increased traffic? What will the alternative of constructing a new building in this area do to these variables?
The analyst should prepare a specific conceptual model that illustrates the flow of relevant causes and effects in the environment. Network and system diagrams are the preferred tools for accomplishing the conceptual model. Once the cause and effect pathways are identified, the model can be simplified to focus on the pathways that are anticipated to be most crucial in creating significant disturbances to the environment. The CEQ guidance provides further direction on preparing conceptual models and lists a number of references that discuss conceptual modeling in greater detail.

Step 9. Determine the magnitude and significance of cumulative effects. This step comprises the end goal of the assessment process. The analyst should compare the conceptual model developed in the previous step to the baseline environmental conditions defined in Step 7 to quantify the anticipated cumulative effects of the project in the context of past, present and future actions. Questions to ask are:

Figure 2
Possible Sources of Existing Data for Cumulative Effects Analysis*

Individuals	• Former and present landholders • Long-time residents • Long-time resource users • Long-time resource managers
Historical societies	Local, state, and regional societies provide: • Former and present landholders • Long-time residents • Long-time resource users • Long-time resource managers
Schools and universities	• Central libraries • Natural history or cultural resources collections or museums • Field stations • Faculty in history and natural and social sciences

Other collections	Private, city, state, or federal collections in: • Archaeology • Botany • Zoology • Natural history
Natural history surveys	• Private • State • National
Private organizations	• Land preservation • Habitat preservation • Conservation • Cultural resources history • Religious institutions • Chambers of commerce • Voluntary neighborhood organizations
Governmental agencies	• Local park districts • Local planning agencies • Local records-keeping agencies • State and federal land management agencies • State and federal fish, wildlife, and conservation agencies • State and federal regulatory agencies • State planning agencies • State and federal records-keeping agencies • State and federal surveys • State and federal agricultural and forestry agencies • State historic preservation offices • Indian tribal government planning, natural resource, and cultural resource offices
Project proponent	• Project plans and supporting environmental documentation

***Adapted from Table 3-2 in CEQ publication: "Considering Cumulative Effects Under the National Environmental Policy Act"**

- How seriously does it appear that the proposed action may contribute to negative cumulative effects, and what opportunities exist for contributing to positive effects?
- To what extent is it likely that the direct and indirect impacts of the proposed action will push a key environmental variable over the threshold into catastrophic decline, or conversely, allow it to rise above a threshold of viable recovery?

If possible, the magnitude and significance of cumulative effects should be presented in some kind of quantitative terms, even if the precise values assigned to each variable are somewhat speculative. Figure 3 illustrates a set of quantitative impact projections. The complexity of the cause-and-effect conceptual model should give clues to how cumulative effects may be calculated. Computer-based modeling is the preferred method for quantifying complex cause-and-effect relationships leading to cumulative effects. Many models have been developed, but may require more data than is available and can be expensive. In addition, some impact and resource types are not amenable to quantification. These should not be ignored simply because they are not quantifiable; narrative descriptions of effects should be presented instead (See Figure 4).

Two types of analyses are frequently performed for evaluating effects on human communities. These are economic impact analysis and social impact analysis. Economic impact is generally evaluated in terms of four factors: changes in business activity, changes in employment, changes in income, and changes in population. Other factors are also assessed as appropriate. A large number of economic models are available for use in cumulative effects analysis, and vary widely in complexity and ease of application. One model widely used is the Economic Impact Forecast System (EIFS). Social impact analysis uses five basic categories of variables: population characteristics, community and institutional structures, political and social resources, individual and family changes, and community resources. Again these factors can be evaluated in a number of ways, using methods chosen to be appropriate to the proposed action. Linear projections of historical trends, population multipliers, hypothetical scenarios, expert testimony, and simulation modeling are all methods commonly employed (see NEPA Call-In fact sheet, "Social Impact Assessment"). Social impact analysis should include analysis of potential cumulative impacts on cultural resources such as historic places and community values.

Chapter 5 and Appendix A of the CEQ guidance provides more information on specific methods of analysis. The end result of the modeling effort is a means of assessing the significance of potential cumulative effects. Significant effects are those that are inherently intense, have large geographic extent, or are persistent in time. Criteria for significance must be explicitly described before the significance of the effects is determined. In this way, the results of the cumulative effects assessment can be evaluated on the basis of known criteria.

Step 10. Modify or add alternative actions. If significant cumulative effects are identified as likely results of a proposed action, NEPA requires the proposing agency to consider ways to avoid, minimize, or mitigate them. Since cumulative effects by definition arise from multiple sources, not all of which are usually under the control of a single agency, their mitigation often requires interagency cooperation, often over relatively long periods of time.

In some cases, cumulative effects analysis leads to rejection of an alternative, or even opting for the no-action alternative. If there is no way to keep air operations at the closing Air Force from adding to the stress already operating on the speckled sparrow population, then the alternative of using the base as an air freight facility may have to be rejected.

In other cases, working with other Federal and state agencies, Indian tribes, or local planning and zoning authorities may make it possible to reduce, redirect, or otherwise mitigate adverse cumulative effects. For example, it may be possible for GSA to work with city planning, tax, and zoning bodies, and perhaps a local historic district commission, to put administrative controls on development in the vicinity of the existing and proposed office buildings, or to provide tax incentives to businesses or residents who maintain the neighborhood's character.

In other cases, it may be that cumulative effects are inevitable in the project impact area, but can be compensated for by taking actions elsewhere. For example, GSA might contribute to a fund to purchase and restore speckled sparrow habitat, as compensation for the inevitable impacts of necessary air operations at the old Air Force base.

Step 11. Monitor cumulative effects of the selected alternative. In most cases it remains uncertain, when cumulative effects analysis is done and a decision has been made about alternatives and mitigation, whether the selected mitigation measures will fully address the actual effects. Actual cumulative effects may be greater, less severe, or different in kind from those anticipated. As a result, it is important to monitor the actual, ongoing cumulative effects of actions after project decisions are made, and to make adjustments in mitigation measures as needed. Such monitoring should be built into mitigation plans, with the responsibility for making adjustments to such plans assigned to parties with the authority and ability to make them. Often these parties will be local, regional, State, or Indian tribal officials rather than an agency like GSA, but GSA should work with such officials in establishing a monitoring and mitigation program that is likely to work. Information gained during monitoring will also be invaluable in improving cumulative effects analysis on similar projects in the future.

Figure 3
EXAMPLE TABLE USING QUANTITATIVE DESCRIPTION OF EFFECTS (WITHIN A GIVEN LEVEL OF UNCERTAINTY) OF VARIOUS RESOURCES

Resource	Past Actions	Present Actions	Proposed Action	Future Actions	Cumulative Effect
Air Quality	No effect on SO2	20% increase in SO2	10% increase in SO2	5% increase in SO2	35% increase in SO2
Fish	50% of 1950 population lost	2% of fish population lost	5% increase in fish population	1% of fish population lost	48% of 1950 fish population lost
Wetlands	78% of presettlement wetlands lost	1% of existing wetlands lost annually for 5 years	0.5% of existing wetlands lost	1.5% of existing wetlands lost annually for 10 years	95% of presettlement wetlands lost in 10 years

Adapted from Table 4-1 in CEQ publication: "Considering Cumulative Effects Under the National Environmental Policy Act"

Figure 4
EXAMPLE TABLE USING NARRATIVE DESCRIPTION OF EFFECTS ON VARIOUS RESOURCES

Resource	Past Actions	Present Actions	Proposed Action	Future Actions	Cumulative Effect
Air Quality	Impacts Dissipated	Noticeable deterioration in visibility during summer, but standards met	Visibility affected during operations, but standards met	Increase in auto emissions expected	Standards possibly violated
Fish	Decrease in numbers and species diversity	Occasional documented fish kills	Increase in number of fish kills	Loss of cold-water species due to change in temperature	Significant decline in numbers and species diversity
Wetlands	Large reduction in acreage of wetlands	Loss of small amount of wetland annually	Disturbance of a 5 acre wetland	Disturbance of a 5 acre wetland	Significant cumulative loss of wetlands

***Adapted from Table 4-3 in CEQ publication: "Considering Cumulative Effects Under the National Environmental Policy Act"**

Conclusion

Cumulative effects analysis involves the prediction of effects arising from multiple interacting sources over relatively long periods of time. It is more complicated and uncertain than the analysis of direct or easily foreseeable indirect impacts, but it can be done, and it is important to do it in order to address the fundamental requirements of NEPA. In summary, the NEPA analyst should:

- Determine which resources, ecosystems, and human communities may be subject to cumulative effects;
- Establish the geographic and temporal scope of the NEPA analysis broadly enough to address cumulative effects;
- In the analysis, address the impacts of past, present, and reasonably foreseeable future actions by parties other than the responsible agency;
- Establish a dynamic baseline of ongoing and potential cumulative effects without the action under analysis, against which to analyze the specific action's contribution to cumulative effects.
- Use networks or systems diagrams to identify important cause-and-effect pathways;
- Determine the magnitude and significance of cumulative effects of both the proposed action and alternatives using models of appropriate complexity;
- Evaluate effects in the context of sustainable development and thresholds for significant impacts; and
- Address uncertainty in forecasting cumulative effects and use monitoring and adaptive management to limit significant unforeseen consequences.

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